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In a preliminary experiment using the above plant protein supplements in yellow corn-based diets, it was shown that the performances of laying hens were essentially equal and that of hens on meat and bone meal was inferior or poor. A subsequent experiment was designed to investigate how meat and bone meal could best be utilized in laying hen rations when combined with soybean and/or sunflower meal.

A total of 720 Shaver-288 pullets at 33 weeks of age were distributed into a randomized complete block experimental design involving ten treatments. There were six replicates per treatment with twelve birds per replicate (14 birds per cage in three cages). Rations were formulated using yellow corn and either soybean meal, sunflower meal, meat and bone meal or meat and bone meal in combination with soybean meal or sunflower meal, respectively. Diets were formulated to provide 16% and 12% protein with the 12% protein diets being augmented to supply the minimum NRC requirements for the sulphur amino acids and lysine. Performance data were collected for thirteen 28-day periods.

As indicated in Table 1, hens on the combination of sunflower meal with meat and bone meal showed superior production over those on the combination of soybean with meat and bone meal. This was evidenced at both levels of protein.

Hens on either soybean or sunflower meals as the only protein supplements to the 16% protein diets maintained high performance as reported in the first experiment. Hens on the sunflower meal diet showed relatively better performance than those on soybean meal at the 12% protein level.

Hens on meat and bone meal as the main source of protein showed poor performance as before. However, as indicated when meat and bone meal were combined with other protein supplements, performance was satisfactory whether furnishing up to 80% of the supplemental protein at the 16% protein level or 50% at the 12% protein level. Thus, there is potential for utilizing meat and bone meal in laying hen rations beyond the traditional minute inclusions to provide calcium and phosphorus. Further studies need to be made to assure the repeatability of this seemingly synergestic effect of meat and bone meal with sunflower meal and to ascertain reasons for poor performance when meat and bone meal is the only supplement.

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Table 1. Performance of Laying Hens as Affected by Protein Supplement and Level

	Egg production, H-D %	Feed intake, g	Egg/100 g feed, g	Haugh units	Body wt, kg
16% protein					
Soybean meal	77.4	124	41	79.2	1.76
Sunflower meal	75.5	132	38	80.5	1.75
Meat and bone meal	65.8	114	37	81.6	1.60
Soybean and meat and bone meal	73.4	122	39	79.2	1.78
Sunflower and meat and bone meal	76.8	122	41	79.6	1.80
12% protein					
Soybean meal	71.1	118	40	79.5	1.76
Sunflower meal	74.8	130	37	81.1	1.70
Meat and bone meal	43.3	99	27	84.6	1.48
Soybean and meat and bone meal	66.3	111	38	82.5	1.55
Sunflower and meat and bone meal	71.5	121	38	81.2	1.66
Combination					
Soybean meal	74.3^{a}	$121^{b,c}$	40^{a}	79.3^{c}	1.76^{b}
Sunflower meal	75.2^{a}	131^{a}	38^{c}	80.8^{b}	1.72^{b}
Meat and bone meal	54.6^{c}	107^{d}	32^{d}	83.1^{a}	1.54^{a}
Soybean and meat and bone meal	59.9^{b}	117^{c}	$39^{b,c}$	80.9^{b}	$1.66^{a,b}$
Sunflower and meat and bone meal	74.2^{a}	122^{b}	$39^{a,b}$	$80.4^{b,c}$	1.73^{b}

^{a,b,c,d} Data differ significantly ($P>.05$).